

surface of water on muslin at any moment, but a properly constructed evaporimeter may be made to give us the *quantity of water evaporated from a similar surface during any interval of time*. Such an evaporimeter, therefore, would sum up or integrate the effect of those influences that determine the temperature as given by the wet bulb, and from it, therefore, the average humidity of the air during any given interval of time may be deduced. Instead of attempting to make a self-registering wet-bulb thermometer we may use the evaporimeter as an equivalent. The formula for determining the average vapor tension during an hour was given in 1887, at page 376 of the *Treatise on Meteorological Apparatus and Methods* (in the section on the use of the evaporimeter as an integrating hygrometer), as based on the careful measurements made by Mr. Desmond Fitzgerald and published in the *Transactions of the American Society of Civil Engineers*, 1886. Let p be the average vapor tension in the free air, P the vapor tension corresponding to the temperature of the evaporating water (both of these tensions are to be expressed in inches of the mercurial barometer, and as the evaporimeter was within the ordinary thermometer shelter, therefore, the temperature of the water corresponded closely with the temperature of the air and the vapor tension P was that for the average temperature of the air during the interval of observed evaporation); W the velocity of the wind in miles per hour as measured by the Robinson anemometer at the level of the surface of the evaporating water; E the observed depth of water evaporated in an hour and expressed in inches. With this notation the approximate formula that represents Mr. Fitzgerald's observations reads:

$$p = P - \frac{60E}{1 + \frac{1}{2}W} = P - 60 \frac{E}{W} \cdot \frac{1}{\frac{1}{2} + 0.5}$$

An additional factor depending on the atmospheric pressure should probably be introduced, but would only become important at elevated stations.

It is much to be desired that one or more new series of accurate measurements of evaporation, wind velocity, temperature, and dew-point be made at high and low stations in instrument shelters similar to those used by the Weather Bureau, in order that a general empirical formula may be devised for use with the evaporimeter considered as an integrating hygrometer.

WET-BULB OR SENSIBLE TEMPERATURES.

The sensation of heat experienced by the human body and attributed to the atmosphere depends not merely upon the temperature of the air, but especially upon its dryness and the force of the wind. Physiologists have explained this nervous sensation, erroneously called subjective temperature, as a condition due to the more or less rapid evaporation of the natural perspiration and the consequent drying of the outer layers of the skin.

Investigations were made into the relations between the moisture of the air and its physiological effects by Mr. J. W. Osborne, of Washington (see the *Proceedings of the American Association for the Advancement of Science*, 1876), and especially by the Chief of the Weather Bureau (see his memoir on "Sensible Temperatures," read before the American Climatological Association, June 1, 1894). It would seem that the rapid evaporation from the skin in dry, hot weather reduces the temperature of the layer of nerve cells at the surface of the skin. This reduction is not measurable by thermometers which give the temperature of large masses, but is appreciated by the minute nerves that end in these microscopic cells. This reduction of temperature, or sensible coolness, is apparently proportional to the reduction of temperature shown by the difference between the dry and wet bulb thermometers, and as shown by the chart accompanying Professor Harrington's memoir, it amounts on the average to 20° in the month of July in Arizona, Nevada, and Utah and 10° in Kentucky, Indiana, and Ohio.

The resulting sensible temperatures, as shown on his second chart, are simply the so-called average temperatures of the wet-bulb thermometer as obtained by the whirling apparatus used in the shaded shelter, and correspond to the surface or skin temperatures of persons standing in the shade of trees or houses exposed to a natural breeze of at least 6 miles per hour. The temperature of the wet-bulb thermometer and its depression below the dry bulb are the fundamental data for all investigations into the relation between human physiology and the atmosphere. In order to present a monthly summary of the atmospheric conditions from a hygienic and physiological point of view, Table Ia has been prepared, showing the maximum, minimum, and mean readings of the wet-bulb thermometer at 8 a. m. and 8 p. m., seventy-fifth meridian time.

PRECIPITATION.

[In inches and hundredths.]

The distribution of precipitation for the month of October, 1894, as determined by reports from about 2,000 stations, is exhibited on Chart III. The numerical details are given in Tables I, II, and III; the first of these also gives the average departures from the normal for each district, whereas the average departure for each State is given in Table XII for each State Weather Service.

DIURNAL VARIATION.

Table IVb gives the total precipitation for each hour of seventy-fifth meridian time, as deduced from self-registering gauges kept at about 43 regular stations of the Weather Bureau; of these 27 are float gauges and 6 are weighing gauges.

NORMAL PRECIPITATION FOR OCTOBER.

The normal precipitation for October is shown on Chart IX of the *Atlas of Bulletin C*, entitled "Rainfall and Snow of the United States, Compiled to the End of 1891, with Annual, Seasonal, Monthly, and other Charts," by Mark W. Harrington, Chief of the Weather Bureau, Washington, 1894. From this chart it appears that the region of greatest rain-

fall in October is over 9 inches in the extreme northwest corner of Washington; the next largest rainfalls are over 6 inches in the southeastern end of Florida and the neighborhood of Cape Hatteras. The region of 3 inches, or over, covers the western quarter of Washington and Oregon and nearly all of the Atlantic and Gulf coasts, extending inland to a distance that varies from 100 miles in southern Texas to 300 miles in New England.

PRECIPITATION FOR CURRENT MONTH.

The precipitation for the current October was heaviest on the coasts of Washington and Oregon, where it ranged from 9 to 17 inches. Heavy precipitation, viz, above 8 inches, occurred at Narragansett Pier, Vineyard Haven, Woods Holl, and Nantucket. The precipitation averaged 1 inch, or less, in Mississippi, Tennessee, Illinois, and westward from the Mississippi River to the Rocky Mountains, and in southern California.

CURRENT DEPARTURES FROM NORMAL PRECIPITATION.

The precipitation for October was in excess on the coast of

Washington, along the Atlantic coast from Maine to North Carolina, and in the extreme northern portion of the United States from Maine to Idaho. There was a deficiency, with few exceptions, from the Gulf States to the fortieth parallel of latitude.

The principal departures from the normal at Weather Bureau stations were as follows:

Excesses.—Vineyard Haven, 6.6; Astoria, 6.1; Nantucket, 5.0; Fort Canby, 4.7; Neah Bay, 3.7; Tatoosh Island, 3.5; St. Paul, 2.6; New York, 2.4; Duluth, 2.2.

Deficits.—Galveston, 4.4; Corpus Christi, 3.2; Palestine, 2.8; Springfield, Ill., Chicago, and Memphis, 2.6; New Orleans, 2.5; Jacksonville, 2.4; Nashville and Kansas City, 2.2; Titusville, 2.1; Springfield, Mo., 2.0.

Considered by districts, the precipitation for October, 1894, when compared with the normal for the month, furnishes the departures given in Table I, as expressed in inches. By dividing those departures by the normal precipitation for October we obtain the following corresponding percentages (precipitation is in excess when the percentage of the normal exceeds 100):

Above the normal: New England, 156; middle Atlantic, 136; south Atlantic, 112; Key West, 130; lower Lake, 112; North Dakota (extreme northwest), 125; northern plateau, 105; north Pacific, 146; middle Pacific, 106.

Below the normal: east Gulf, 84; west Gulf, 45; Ohio Valley and Tennessee, 49; upper Lake, 91; upper Mississippi, 62; Missouri Valley, 77; northern slope, 88; middle slope, 67; southern slope (Abilene), 38; southern plateau, 87; middle plateau, 76; southern Pacific, 21.

For certain voluntary stations of rather long periods of observation the normal and extreme monthly precipitations and the departures are shown in detail in Table X^b, which is now placed among the meteorological tables instead of being inserted in the text as heretofore.

YEARS OF GREATEST PRECIPITATION FOR OCTOBER.

The precipitation for the current month was the greatest on record for the month of October at regular Weather Bureau stations, as shown in the following table:

Station.	Current precipitation.		Previous maximum.	
	Amount.	Departure.	Amount.	Year.
Fort Canby, Wash	10.12	+4.7	8.08	1889
Astoria, Oreg	12.19	+6.1	9.64	1889
Havre, Mont	1.73	+1.2	1.47	1890
Duluth, Minn	4.99	+2.2	4.92	1877
St. Paul, Minn	4.49	+2.6	4.44	1881
Nantucket, Mass	10.05	+5.0	6.72	1890
Vineyard Haven, Mass	10.88	+6.6	7.57	1891

YEARS OF LEAST PRECIPITATION FOR OCTOBER.

The precipitation for the current month was the least on record for the month of October at regular Weather Bureau stations, as shown in the following table:

Station.	Current precipitation.		Previous minimum.	
	Amount.	Departure.	Amount.	Year.
Lander, Wyo	0.03	— 1.1	0.88	1888
Rapid City, S. Dak	0.16	— 0.4	0.34	1891
Memphis, Tenn	0.55	— 2.6	0.59	1886

ACCUMULATED PRECIPITATION.

The total accumulated monthly departures from normal precipitation from the beginning of the year to the end of the current month are given in the second column of the fol-

lowing table; the third column gives the ratio of the current accumulated precipitation to its normal value:

District.	Accumulated departure.	Accumulated precipitation.	District.	Accumulated departure.	Accumulated precipitation.
	Inch.	Per ct.		Inch.	Per ct.
New England	8.60	78	Key West	+5.20	114
Middle Atlantic	4.20	89	Middle slope	+0.90	105
South Atlantic	1.80	94	Middle plateau	+1.00	110
East Gulf	4.70	90	Northern plateau	+2.90	119
West Gulf	2.00	95	North Pacific	+14.30	133
Ohio Valley and Tennessee	8.90	78			
Lower Lake	3.60	88			
Upper Lake	1.40	95			
North Dakota (Ex. N.W.)	0.10	99			
Upper Mississippi	10.80	66			
Missouri Valley	7.64	74			
Northern slope	1.00	92			
Southern slope (Abilene)	0.20	99			
Southern plateau	3.60	64			
Middle Pacific	1.20	91			
South Pacific	4.70	51			

EXCESSIVE PRECIPITATION.

The following table for October, 1894, shows, by States, the individual stations reporting total precipitation to equal or exceed 10.00 inches during this month, 2.50 in 24 hours, and 1.00 in 1 hour:

Excessive precipitation, by stations, for October, 1894.

State and station.	Monthly rainfall 10 inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall 1 inch, or more, in one hour.	
		Amt.	Day.	Amt.	Time.
Alabama.	Inches.	Inches.		Inches.	h. m.
Bermuda	2.80	8			
Claiborne Landing	3.20	7-8			
Daphne	5.27	7-8			
Eufaula	3.15	7-8			
Evergreen	4.79	7-8			
Fort Deposit	4.40	7-8			
Highland Home	3.85	8-9		1.95	1 45
Mobile	3.39	7-8			
Mount Willing	3.50	6			
Newton	5.31	7-8			
Union Springs	5.05	8-9			
Arizona.				1.25	1 00
Farleys Camp					26
Arkansas.				1.25	1 00
Lonoke				1.10	1 00
New Gascony				1.00	0 35
Pine Bluff					2
California.					
La Porte	3.17	20			
Connecticut.					
Canton	2.73	10			
Hartford	2.63	10			
Middletown	2.50	10			
Do	2.95	24-25			
New London	2.50	24-25			
Norwalk	2.50	24-25			
West Simsbury	2.78	10			
Florida.				1.82	1 00
Jacksonville	2.63	6-7		1.31	1 15
Jupiter				1.85	0 33
Key West	3.49	4-5		1.16	1 02
Do					11
Lake	2.84	8-9			
Moseley Hall	4.65	8-9			
Do	2.53	29-30			
New Smyrna				1.18	0 45
Orange Park	3.00	6			13
Orlando	2.63	13			
Pensacola	2.53	7-8			
Tampa				1.51	0 40
Georgia.					8
Alapaha	5.14	8-9			
Albany	3.73	9			
Americus	3.05	8-9			
Athens	3.12	8-9			
Augusta	2.80	8-9			
Bainbridge	5.60	8-9			
Blakeley	5.80	8			
Bragg	3.05	8-9			
Camak	3.00	8-9			
Columbus	5.12	7-8			
Dublin	3.50	8			
Dublin	3.15	8			
Elberton	4.06	7-8			
Forsyth	3.14	8-9			
Fort Gaines	4.42	9		4.42	4 00
Hawkinsville	3.20	9			9
Hephzibah	3.70	9			
Louisville	3.03	9			

Excessive precipitation—Continued.

State and station.	Monthly rainfall in inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch, or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
Georgia—Cont'd.						
Marshallville	Inches.	Inches.		Inches	h. m.	
Millen		3.40	8			
Monticello		4.55	9			
Morgan		3.40	9			
Piscola		4.48	8			
Point Peter		5.00	8-9			
Poulan		3.80	8-9			
Quitman		4.24	8-9			
Reynolds		3.30	9			
Talbotton		4.20	7-9			
Thomasville		5.67	8-9			
Washington		3.08	8-9			
Waynesboro		3.25	8-9			
		4.82	8			
Indian Territory.						
Lehigh		2.77	2			
Iowa.						
Ames b		3.46	20-21	2.17	1 00	20
Ames c		3.23	20			
Atlantic		2.77	1			
Kansas.						
Atchison		2.82	18-19			
Wakefield		2.78	1	1.85	1 00	1
Kentucky.						
Cromwell				1.42	1 00	12
Maryland.						
Darlington		2.50	9			
Pocomoke City		2.60	9-10			
Woodstock		2.65	9-10			
Massachusetts.						
Brockton c		2.63	25-26			
Hyannis		2.90	25-26			
Leeds		2.80	10			
Long Plain		2.82	25-26			
Mansfield		2.50	25-26			
Middleboro		3.46	25-26			
Nantucket	10.05	2.77	4-5			
Do.		3.40	25-26			
New Bedford a		2.62	25-26			
New Bedford b		3.70	25-26			
Somerset		3.38	25-26			
Vineyard Haven	10.88	5.40	25-26			
Woods Holl		3.80	25-26			
Minnesota.						
Red Wing		3.00	20-21			
Mississippi.						
Leakesville		4.53	3			
Moss Point		3.35	8			
Missouri.						
Platte River		3.52	18			
Sublette		3.00	21			
Nebraska.						
Auburn		2.88	1			
Crete		2.50	1			
Nebraska City		3.25	1			
Teoamsch		3.50	1			
New Jersey.						
Billingsport		2.60	10			
Egg Harbor City		2.81	9-10			
Freehold		2.54	10			
Ocean City		2.90	9-10			
New York.						
Marlboro		2.65	10			
Setauket		2.75	24-25			
North Carolina.						
Auburn		2.55	9			
Bailey		2.71	9			
Chapel Hill		2.65	9-10			
Charlotte		3.80	8-9			
Experiment Farm		3.50	9			
Fair Bluff		4.73	9			
Do.		3.22	20	3.22	2 30	20
Falkland		4.25	9			
Fayetteville		4.85	9			
Do.		2.76	27			
Goldsboro		3.53	8-9			
Henderson		2.50	9			
Lilesville		3.00	9			
Littleton		2.88	8-9			
Louisburg		2.70	9			
Lumberton		5.38	9			
Mocksville		2.64	9			
Moncure		2.91	9			
Mount Pleasant		4.28	8-9			
Pantego		3.80	9			
Pittsboro		2.54	9			
Raleigh (W. B.)		3.97	8-9			
Raleigh (V. O.)		3.70	9			
Rockingham		4.00	8-9			
Salisbury		3.50	9			
Selma		4.05	9			
Skyuka		2.92	9			
Sloan		5.05	9			
Southern Pines		3.82	9			
Tarboro		3.46	9			
Willeton		3.00	28			
Wilmington				2.06	1 50	4
Oregon.						
Astoria	12.19					
Bandon	9.84					
Detroit	11.34					
Glenora	17.30					

Excessive precipitation—Continued.

State and station.	Monthly rainfall in inches, or more.	Rainfall 2.50 inches, or more, in 24 hours.		Rainfall of 1 inch or more, in one hour.		
		Amt.	Day.	Amt.	Time.	Day.
<i>Oregon—Cont'd.</i>						
Langlois	<i>Inches.</i> 11.33	<i>Inches.</i>		<i>Inches.</i>	<i>h. m.</i>	
Nehalem	13.03					
Tillamook Rock L. H.	10.30					
<i>Pennsylvania.</i>						
Browsers Lock		2.99	10			
Coatesville		3.19	9-10			
East Mauch Chunk		3.46	10			
Girardville		2.92	9			
Lansdale		2.61	11			
Lebanon		2.85	9-10			
Phoenixville		3.41	9-10			
Pottstown		2.55	9-10			
Reading		3.57	10			
Seisholtzville		2.85	10			
Selma Grove				1.64	1 30	3
Westtown		2.60	10			
Wilkesbarre		4.02	10			
<i>South Carolina.</i>						
Allendale		3.40	9			
Anderson		3.53	8-9			
Batesburg		5.02				
Blackville		3.50	8-9			
Blenheim		5.30	8-9			
Camden		3.15		2.00	2 00	27
Charleston		3.07	8-9			
Cheraw a		4.10	8-9			
Cheraw b		5.15	8-9			
Columbia		3.19	8-9			
Conway		3.80	8-9			
Cross Hill		4.62	8-9			
Edisto		2.65	8-9			
Effingham		2.75	8-9			
Flint Hill		3.90	8-9			
Florence		3.48	8-9			
Georgetown		3.52	8-9			
Hardeeville		3.12	8-9			
Hollands Store		3.26	8-9			
Kingstree a		3.99	8-9			
Kingstree b		3.30	8-9			
Little Mountain		4.00	8-9			
Longshore		4.13	8-9			
McCormick		3.50	8-9			
Mount Carmel		3.41	8-9			
Pinopolis		3.15	8-9			
Santuck		5.14	8-9			
Shaws Fork		3.95	8-9			
Society Hill		3.65	8-9			
Spartanburg		2.55	8-9			
Statesburg		2.59	8-9			
Trenton		5.55	8-9			
Watts		3.60	8-9			
Yorkville		3.95	8-9			
<i>Virginia.</i>						
Birdsneest		2.80	10-11			
Buckingham		2.82	9			
Norfolk		3.00	9-10			
Richmond (near)		2.51	10			
<i>Washington.</i>						
Cascade Tunnel	11.47					
East Clallam	10.95					
Fort Canby	10.12					
Index	10.33					
Neah Bay	13.93					
Stampede	10.30					
Tatoosh Island	12.70					
Union City	10.47					
<i>West Virginia.</i>						
Weston a				1.66	1 30	22
<i>Wisconsin.</i>						
Ashland		3.80	25-26			

By examining the preceding table it will be seen that the most interesting cases of excessive precipitation in twenty-four hours occurred on the 7th and 8th in Alabama; 8th, 9th, and 10th, in Georgia, North and South Carolina, in connection with low area No. IV, and on the 24th and 25th in Connecticut and Massachusetts, in connection with low area No. XVI.

The following tables give a summary of the preceding table and show the number of stations in each State reporting excessive precipitation during this month:

Monthly precipitation to equal or exceed 10.00 inches.

State.	Number of stations.	State.	Number of stations.
Washington	8	Massachusetts	2
Oregon	7		

Daily precipitation to equal or exceed 2.50 in 24 hours.

State.	Number of stations.	Dates.	State.	Number of stations.	Dates.
South Carolina....	34	8, 8-9, 9.	Virginia.....	4	9, 9-10, 10, 10-11.
Georgia.....	31	7-8, 8, 8-9, 9.	Iowa.....	3	1, 20, 20-21.
North Carolina....	29	8-9, 9-10, 26, 27, 28.	Maryland.....	2	9, 9-10.
Massachusetts.....	13	4-5, 10, 25-26.	Kansas.....	3	1, 18-19.
Pennsylvania.....	12	9, 9-10, 10, 11.	Mississippi.....	2	3, 8.
Alabama.....	11	7-8, 8, 8-9.	Missouri.....	2	18, 21.
Florida.....	7	4-5, 6, 6-7, 7-8, 8-9, 13, 29-30.	New York.....	2	10, 24-25.
Connecticut.....	6	10, 24-25.	California.....	1	20.
Nebraska.....	4	1.	Indian Territory.	1	21.
New Jersey.....	4	9-10, 10.	Michigan.....	1	20-21.
			Wisconsin.....	1	25-26.

Hourly precipitation to equal or exceed 1.00 inch.

Florida.....	5	4, 6, 8, 11, 12, 13.	Iowa.....	1	20.
Arkansas.....	3	2.	Kansas.....	1	1.
North Carolina....	2	4, 26.	Kentucky.....	1	12.
Alabama.....	1	4.	Pennsylvania.....	1	3.
Arizona.....	1	26.	South Carolina....	1	27.
Georgia.....	1	9.	West Virginia...	1	22.

FREQUENCY OF EXCESSIVE PRECIPITATION.

The following tables show the frequency of excessive precipitation or the number of years for which monthly precipitation to equal or exceed 10.00 inches, daily precipitation to equal or exceed 2.50 inches, and hourly precipitation to equal or exceed 1.00 inch has been reported in the several States and Territories for October during the last twenty-four years:

Frequency of excessive monthly precipitation.

State.	No. years noted.	State.	No. years noted.
Florida.....	14	Alabama.....	1
Texas.....	10	Arkansas.....	1
North Carolina....	8	Connecticut.....	1
Oregon.....	7	District of Columbia	1
Washington.....	7	Illinois.....	1
Georgia.....	7	Indiana.....	1
New Hampshire.....	5	Indian Territory...	1
Louisiana.....	4	Iowa.....	1
New York.....	4	Kansas.....	1
California.....	4	Kentucky.....	1
Michigan.....	3	Maine.....	1
Massachusetts.....	3	Mississippi.....	1
Virginia.....	3	New Jersey.....	1
Maryland.....	2	Ohio.....	1
Missouri.....	2	Rhode Island.....	1
South Carolina....	2	Tennessee.....	1

Frequency of excessive daily precipitation.

Florida.....	19	Michigan.....	7
North Carolina....	17	District of Columbia	6
Texas.....	16	Ohio.....	6
Louisiana.....	14	Indian Territory...	6
Georgia.....	14	Wisconsin.....	6
Pennsylvania.....	12	Oregon.....	5
Illinois.....	11	Arkansas.....	4
New York.....	11	Tennessee.....	4
South Carolina....	11	North and South Dakota	4
Alabama.....	10	Kentucky.....	4
Maryland.....	10	Minnesota.....	4
Missouri.....	10	New Hampshire.....	4
Massachusetts.....	10	Washington.....	4
Virginia.....	10	Indiana.....	3
Rhode Island.....	9	California.....	3
Connecticut.....	9	West Virginia...	2
New Jersey.....	9	New Mexico.....	1
Maine.....	8	Utah.....	1
Nebraska.....	8	Vermont.....	1
Mississippi.....	8	Delaware.....	1
Iowa.....	8	Montana.....	1
		Wyoming.....	1

Frequency of excessive hourly precipitation.

Texas.....	10	Arkansas.....	2
Iowa.....	7	Pennsylvania.....	2
Florida.....	6	Connecticut.....	1
Kansas.....	5	Indian Territory...	1
North Carolina....	5	Maryland.....	1
Illinois.....	4	Mississippi.....	1
Louisiana.....	4	New Jersey.....	1
Georgia.....	4	New York.....	1
Nebraska.....	3	Ohio.....	1
Alabama.....	3	Wisconsin.....	1
South Carolina....	3	Arizona.....	1
District of Columbia	2	Kentucky.....	1
Indiana.....	2	West Virginia...	1
Missouri.....	2		

MAXIMUM RAINFALL FROM SELF-REGISTERING GAUGES.

The following table gives the heaviest rainfall during October, 1894, for periods of 5, 10, and 60 minutes, as recorded on self-registering rain gauges at regular stations of the Weather Bureau. This record refers strictly to rainfall. About 37 stations are furnished with self-registering float rain gauges and 6 with the self-registering-weighing rain-and-snow gauge. The float gauge does not record snowfall, and both forms are liable to be interrupted by snow or ice:

Maximum rainfall in one hour or less.

Station.	Maximum rainfall in—					
	5 min.	Date.	10 min.	Date.	1 hour.	Date.
Atlanta, Ga.*.....	Inch. 0.02	8	Inch. 0.04	8	Inch. 0.16	8
Baltimore, Md.....	0.07	31	0.10	10, 31	0.40	10
Bismarck, N. Dak.....	.....	.....	0.01	1, 28	0.05	28
Boston, Mass.....	0.07	10	0.13	10	0.40	10
Buffalo, N. Y.*.....	0.06	13	0.14	13	0.24	13
Chicago, Ill.*.....	0.05	21	0.10	21	0.28	21
Cincinnati, Ohio.....	0.03	26	0.05	26	0.15	26
Cleveland, Ohio.....	0.06	1	0.10	1	0.22	5
Denver, Colo.....	0.01	27	0.02	27	0.07	27
Detroit, Mich.....	0.16	3	0.19	3	0.35	3
Dodge City, Kans.....	0.10	5	0.20	5	0.30	5
Duluth, Minn.....	0.06	7	0.11	7	0.28	25
Eastport, Me.....	0.03	9, 14	0.06	9, 14	0.25	9
Galveston, Tex.....	0.07	28	0.11	28	0.17	28
Indianapolis, Ind.....	0.20	1	0.30	1	0.65	1
Jacksonville, Fla.....	0.35	6	0.59	6	1.82	6
Jupiter, Fla.....	0.28	12	0.40	12	1.19	12
Kansas City, Mo.....	0.06	18	0.07	1, 8	0.27	1
Key West, Fla.*.....	0.44	4	0.72	4	1.85	4
Louisville.....	0.06	12	0.10	26	0.16	26
Marquette, Mich.....	0.06	21	0.08	21	0.15	3, 13, 21
Memphis, Tenn.....	.....	.....	.....	.....	0.38	28
Milwaukee, Wis.....	0.05	2, 29	0.10	2	0.30	2
Nantucket, Mass.....	0.20	4	0.30	4	0.89	4
Nashville, Tenn.....	0.03	29	0.05	29	0.18	29
New Orleans, La.*.....	0.08	24	0.12	4	0.40	10
New York, N. Y.....	0.13	28	0.19	28	0.75	9
Omaha, Nebr.*.....	.....	.....	.....	.....	.....	.....
Philadelphia, Pa.....	0.13	31	0.20	31	0.35	31
Pittsburg, Pa.....	0.08	22	0.15	22	0.24	22
Portland, Me.....	0.13	4	0.25	4	0.62	4
Portland, Ore.....	0.05	1	0.07	1	0.20	24
Rochester, N. Y.....	0.08	31	0.11	31	0.26	31
St. Louis, Mo.....	0.10	21	0.16	21	0.24	21
St. Paul, Minn.....	0.13	20	0.20	20	0.41	20
Salt Lake City, Utah.....	0.03	27, 31	0.06	27	0.19	27
San Diego, Cal.†.....	.....	.....	0.16	23	0.36	23
San Francisco, Cal.....	0.30	4	0.32	4	0.41	9
Savannah, Ga.....	0.02	21	0.04	21	0.33	21
Seattle, Wash.....	0.17	3	0.32	3	0.60	3
Vicksburg, Miss.....	0.09	31	0.12	31	0.36	31
Washington, D. C.....	0.16	4	0.32	4	1.39	4
Wilmington, N. C.....	.....	.....	.....	.....	.....	.....

*Record incomplete.

†Less than 0.05 in 1 hour.

EXCEPTIONAL PRECIPITATION.

The following tables give exceptionally heavy monthly, daily, and hourly precipitations reported for October, by any station, regular or voluntary, and in any year since 1871:

Exceptional monthly precipitation.

Station and state.	Amt.	Year.	Station and state.	Amt.	Year.
Reidsville, N. C.....	Inches. 29.09?	1885	Mayport, Fla.....	Inches. 20.03	1880
Sims, Cal.....	28.57	1889			

Exceptional daily precipitation.

Station and state.	Amount.	Date.	Station and state.	Amount.	Date.
Fernandina, Fla.....	Inches. 13.14	20-21, 1882	Brewton, Ala.....	5.95	2, 1893
Brackettville, Tex.....	13.08	1-2, 1881	Jupiter, Fla.....	5.95	10-11, 1892
St. Augustine, Fla.....	10.31	9-10, 1880	Blakely, Ga.....	5.80	8, 1894
Key West, Fla.....	9.24	20-21, 1883	Fort Meade, Fla.....	5.75	9, 1891
Newport, Fla.....	8.20	8, 1876	Amelia, Fla.....	5.67	1, 1891
Biloxi, Miss.....	8.00	1-2, 1893	Talbotton, Ga.....	5.67	8-9, 1894
Galveston, Tex.....	7.77	2, 1871	Evergreen, Ala.....	5.63	3, 1893
Mobile, Ala.....	7.47	1-2, 1893	Columbus, N. C.....	5.62	13-14, 1893
Fort Robinson, Nebr.....	7.07	23, 1887	Bainbridge, Ga. b.....	5.60	8-9, 1894
Birdsneat, Va.....	6.85	7-8, 1891	Trenton, S. C.....	5.55	8-9, 1894
Lawrence, La.....	6.00	22, 1892	Vineyard Haven, Mass.....	5.40	25-26, 1894
Avon, Va.....	6.00	13-14, 1893	Saluda, Va.....	5.40	22, 1893
Gainesville, Tex.....	5.98	21-22, 1892	Lumberton, N. C.....	5.38	9, 1894

Exceptional daily precipitation—Continued.

Station and state.	Amount.	Date.	Station and state.	Amount.	Date.
	Inches.			Inches.	
Logtown, Miss.	5.34	1-2, 1893	Abbeville, La.	5.08	21, 1890
Newton, Ala.	5.31	7-8, 1894	Union Springs, Ala.	5.05	8-9, 1894
Blenheim, S. C.	5.30	6-9, 1894	Sloan, N. C.	5.05	9, 1894
Daphne, Ala.	5.27	7-8, 1894	Batesburgh, S. C.	5.02	8-9, 1894
Cheraw, S. C.	5.15	6-9, 1894	Trial, S. C.	5.02	22-23, 1890
Jacksonville, Fla.	5.15	1, 1890	Jordans Grove, Ill.	5.00	11-12, 1893
New Bedford, Mass.	5.15	23-24, 1890	Morganton, N. C.	5.00	13, 1893
Santuck, S. C.	5.14	8-9, 1894	Hillhouse, Ohio	5.00	13-14, 1893
Alapaha, Ga.	5.14	8-9, 1894	Piscola, Ga.	5.00	8-9, 1894
Columbus, Ga.	5.12	7-8, 1894			

Exceptional precipitation for one hour or less.

Station and state.	Amount.	Time.	Date.
	Inches.	h. m.	
Key West, Fla.*	0.44	0 05	4, 1894
Savannah, Ga.	0.38	0 05	3, 1893
Jupiter, Fla.	0.35	0 05	7, 1892
Do	0.35	0 05	10, 1892
Savannah, Ga.	0.35	0 05	22, 1890
Jacksonville, Fla.	0.35	0 05	6, 1894
Key West, Fla.	0.35	0 05	9, 1891
Tampa, Fla.	0.30	0 05	20, 1893
Cleveland, Ohio.	0.30	0 05	13, 1890
Galveston, Tex.	0.30	0 05	30, 1890
Savannah, Ga.	0.30	0 05	4, 1894
Jupiter, Fla.	0.30	0 05	1, 1890
Key West, Fla.	0.30	0 05	10, 1890
New Orleans, La.	0.30	0 05	15, 1890
Jupiter, Fla.	0.28	0 05	12, 1894
Washington, D. C.	0.28	0 05	19, 1891
Vicksburg, Miss.	0.27	0 05	6, 1893
Jupiter, Fla.	0.25	0 05	24, 1893
Brownsville, Tex.	1.20	0 06	23, 1884
Key West, Fla.*	0.72	0 10	4, 1894
Savannah, Ga.	0.63	0 10	3, 1893
Jupiter, Fla.	0.60	0 10	7, 1892
Jacksonville, Fla.	0.59	0 10	6, 1894
Charleston, S. C.	1.35	0 18	3, 1893
Fort Scott, Kans.	1.80	0 20	2, 1881
Cresco, Iowa.	1.11	0 20	10, 1878
Galveston, Tex.	2.12	0 25	30, 1877
Ablene, Tex.	1.50	0 25	24, 1885
De Moines, Iowa.	2.30	0 30	15, 1880
Key West, Fla.	1.85	0 33	4, 1894
Titusville, Fla.	2.60	0 50	12, 1892

* Record incomplete.

MONTHLY SNOWFALL.

The depth of snow that fell during the month of October, as reported by both regular and voluntary observers, is shown in detail, for stations reporting 1 inch or more, in the following table, which also gives the amount lying on the ground on the 15th and at the close of the month. It is also shown on Chart V.

The amount of snowfall on the higher portions of the Rocky Mountain regions, in California, Colorado, Montana, Idaho, Washington, Wyoming, and Alberta was larger than usual at this season of the year.

DEPTH OF SNOW ON GROUND.

The depth of unmelted snow lying on the ground at 8 p. m. of the 15th and 31st is shown in the following table, and was appreciable at only a few stations in Washington and Colorado:

Monthly snowfall and amounts on ground on the 15th and at close of month.

State and station.	Total.	15th.	31st.	State and station.	Total.	15th.	31st.
	Inches.	Ins.	Ins.		Inches.	Ins.	Ins.
California.				Colorado—Cont'd.			
Cisco	9.0			San Juan	3.5		
Fordyce Dam	28.0			San Luis	3.5		
La Porte	5.0			Spring Gulch	18.0		
Summit	29.0			Stamford	4.0		
Colorado.				Steamboat Spring	3.3		
Breckenridge	13.5		2.0	Sunnyside	3.3		
Olimax	20.0			Idaho.			
Divide Ex. Station	1.5			Atlanta	20.0		3.0
Lake Moraine	1.5		1.0	Fraser	5.0		
Moraine	1.0			Grangeville	4.0		
Pagoda (near)	3.0			Lake	11.0		
Red Cliff	20.0			Martin	1.0		
Rico	3.7			Paris	4.0		
Ruby	51.0		18.0	Swan Valley	1.2		

Snowfall of 10 inches or more—Continued.

State and station.	Total.	15th.	31st.	State and station.	Total.	15th.	31st.
	Inches.	Ins.	Ins.		Inches.	Ins.	Ins.
Iowa.				New Mexico.			
Alta	4.0			Halls Peak	4.0		
Clarinda	2.5			New York.			
Larrabee	4.0			Arcade	2.0		
Logan	8.0			Humphrey	2.0		
Panama	4.0			Number Four	1.0		
Maryland.				Saranac Lake	1.0		1.0
Sunnyside	1.0			Turin	2.8		
Massachusetts.				North Dakota.			
Ludlow Center	1.0			Berlin	2.0		
Michigan.				Bottineau	2.3		
Rockland	1.5			Churchs Ferry	1.7		
Minnesota.				Dickinson	2.0		
Alexandria (a, b)	2.0			Forman	4.0		
Bird Island	1.5			Fort Yates	1.0		
Cambridge	2.0			Kelso	4.0		
Campbell	3.0			Larimore	5.6		
Collegeville	1.0			McKinney	1.6		
Fergus Falls	2.8			Napoleon	3.0		
Fort Ripley	1.0			Portal	3.5		
Granite Falls	3.0			Steele	2.0		
Lawrence	1.0			Wahpeton	3.5		
Leech Lake	2.0			White Earth	3.0		
Luverne	2.1			Wild Rice	2.0		
Milan	2.5			Williston	1.2		
Moorhead	3.3	0.0	0.0	Woodbridge	3.0		
Morris	4.2			Oregon.			
Ortonville	2.0			Crook	8.0		
Park Rapids	3.0			Joseph	5.0		
Pokegama Falls	1.2			Siskiyou	2.0		
St. Olaf	3.2			Pennsylvania.			
Sauk Center	1.0		T.	Cassandra	3.0		
Montana.				Clarion	1.5		
Billings	7.3			Grampian	1.0		
Butte	3.5			South Dakota.			
Cascade	3.0			Ashcroft	1.5		
Cokedale	10.0			Bowdle	2.0		
Columbia Falls	2.0			Clark	6.0		
Fort Custer	1.0			Flandreau	2.0		
Fort Logan	2.0			Fort Meade	1.2		
Fort Missoula	1.0			Frankfort	2.0		
Glendive	2.0			Gary	6.0		
Great Falls	1.2			Highmore	2.0		
Havre	3.5			Oelrichs	2.0		
Helena	2.0			Spearfish	4.0		
Hogan	4.0			Webster	6.8		
Kipp	6.5			Washington.			
Marysville	8.4			Cascade Tunnel	11.5	0.0	8.0
Miles City	2.4			Hunters	1.5		
Mingusville	1.0			Waterville	1.0		
Pony	3.0			Wyoming.			
Red Lodge	3.0			Big Horn Ranch	2.0		
Virginia City	7.0			Fort Yellowstone	4.0		
Nebraska.				Sundance	7.0		
David City	2.0			Canadian Stations.			
Fontanelle	1.0			Rockliffe	3.0		
Hay Springs	3.0	0.0	T.	Ferry Sound	1.6		
Norfolk	1.2			Minnedosa	8.1		
Omaha	5.0			Qu'Appelle	15.0		
Wakefield	6.5			Medicine Hat	2.0		
Nevada.				Calgary	1.1		
Fenelon	2.0			Prince Albert	7.6		
Robert Creek	13.0			Edmonton	13.2		
Ruby Valley	1.2			Battleford	2.3		
Stofel	1.0						
Tecoma	1.0						

HAIL.

The following are the dates on which hail fell in the respective States:

Arizona, 1, 18, 19, 26. Arkansas, 2. Colorado, 5, 6, 18, 19, 20. Idaho, 2, 5, 6, 21, 24, 26. Illinois, 2, 6, 19, 21. Indiana, 20. Iowa, 20, 21, 24, 25, 30. Kansas, 6, 12, 18, 20, 27. Louisiana, 28. Maine, 14, 16, 17. Maryland, 13, 23, 24. Massachusetts, 10, 13, 14. Michigan, 3, 6, 9, 11, 12, 13, 22, 23, 31. Minnesota, 2, 6, 12, 13. Missouri, 18 to 21, 28, 29, 30. Montana, 2, 5, 9, 20. Nevada, 17, 18, 19, 26. New Hampshire, 14, 15, 17, 18. New Jersey, 14, 24, 31. New York, 4, 6, 10, 12, 13, 16, 17. North Carolina, 9, 26, 27. North Dakota, 20. Ohio, 3, 7, 13, 14, 22, 24, 27, 31. Pennsylvania, 13, 14, 26, 31. South Carolina, 27, 30. South Dakota, 7. Texas, 27, 28. Utah, 28. Vermont, 17. Washington, 4, 5, 8, 21, 22, 24, 26, 31. West Virginia, 5, 13, 22. Wisconsin, 12, 13, 24.

SLEET.

The following are the dates on which sleet fell in the respective States:

California, 18. Colorado, 1, 2, 3, 5, 6, 7, 10, 11, 15 to 23, 27, 28. Indiana, 30. Iowa, 3, 7, 29, 30. Kansas, 28, 29, 30. Kentucky, 31. Maine, 13, 16. Maryland, 14. Michigan, 8, 10, 13, 14, 15, 25, 31. Minnesota, 3, 7, 10, 28, 29, 30. Mis-

souri, 29, 30, 31. Montana, 5, 6, 20, 25. Nebraska, 6, 7. Nevada, 18, 20, 26. New Hampshire, 15. New Jersey, 14, 24, 31. New Mexico, 20, 27, 31. New York, 13, 14, 15, 17.

North Dakota, 7. Ohio, 13, 14, 31. Pennsylvania, 13, 14. South Dakota, 7, 8, 28. Utah, 31. Washington, 21. Wisconsin, 13, 30. Wyoming, 28.

WIND.

PREVAILING DIRECTIONS.

The prevailing winds for October, 1894, viz, those that were recorded most frequently at Weather Bureau stations, are shown in Tables I and VIII; they are not given on Chart II, as has hitherto been the custom, but the resultant winds are published instead.

RESULTANT WINDS.

The resultant winds for the current month, as deduced from the hourly readings of self-registers at about 67 regular Weather Bureau stations, are given in Table VIII. Other resultants, deduced from the personal observations made at 8 a. m. and 8 p. m., are given in Table IX. These latter resultants are also shown graphically on Chart II, in connection with the isobars based on the same system of simultaneous observation; the small figure attached to each arrow shows the number of hours that this resultant prevailed, on the assumption that each of the morning and evening observations represents one hour's duration of a wind of average velocity; these figures (or the ratio between them and the total number of observations in this month) indicate the extent to which winds from different directions counterbalanced each other. The original north, south, east, and west components are given in detail in Table IX.

During October the resultant movement was generally from the northwest in New England and on the south Pacific coast; from the southwest in the Ohio Valley and Tennessee, lower Lakes, upper Lakes, upper Mississippi, Missouri, middle Pacific coast region, and middle slope; from the northeast in the south Atlantic States and Florida, and southeast in the west Gulf States and northern plateau region.

HIGH WINDS.

Maximum wind velocities of 50 miles, or more, per hour were reported at regular stations of the Weather Bureau as follows (maximum velocities are averages for five minutes; extreme velocities are gusts of shorter duration, and are not given in this table):

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
		Miles.				Miles.	
Amarillo, Tex.	1	50	w.	Fort Canby, Wash.	27	50	se.
Atlantic City, N. J.	10	54	e.	Do.	28	53	e.
Block Island, R. I.	10	84	e.	Do.	29	55	se.
Do.	25	62	ne.	Do.	31	55	se.
Do.	26	68	ne.	Hatteras, N. C.	10	60	sw.
Cape Henry, Va.	9	66	ne.	Jacksonville, Fla.	9	62	se.
Do.	28	62	ne.	Kittyhawk, N. C.	9	58	se.
Cheyenne, Wyo.	1	54	w.	Do.	10	58	sw.
Cleveland, Ohio	11	52	w.	Nantucket, Mass.	10	54	se.
El Paso, Tex.	27	50	sw.	Pensacola, Fla.	8	68	ne.
Fort Canby, Wash.	2	60	se.	Sioux City, Iowa	25	50	nw.
Do.	19	53	se.	Tatoosh Island, Wash.	23	60	e.
Do.	21	64	se.	Woods Holl, Mass.	10	60	sw.
Do.	24	70	se.	Do.	31	58	sw.
Do.	25	72	se.				

LOCAL STORMS.

Destructive or severe local storms were reported as follows:

1st.—Wichita, Kans., windstorm.

2d.—Little Rock, Ark., tornado; 4 persons killed, 26 injured.

3d.—Vicksburg, Miss., thunderstorm.

4th.—Boston, Mass., thunderstorm.

6th.—Jennings, Kans., thunderstorm.

9th.—Columbia, S. C., windstorm.

13th.—Friendship, N. Y., thunderstorm. Brinton, Pa., windstorm.

16th.—Bronson, Mich., cattle killed by lightning.

20th.—Alta, Hopeville, and Ovid, Iowa, windstorms. Kansas City, Mo., and Winfield, Kans., thunderstorms. Hallock, Minn., and Carlisle and Grafton, N. Dak., 1 person killed by lightning at each place.

21st.—Fort Canby, Wash., thunderstorm.

25th.—Near Louisville, Ill., thunderstorm.

26th.—Wilmington, N. C., hailstorm.

28th.—Coushatta, La., hailstorm.

THE TORNADO AT LITTLE ROCK, ARK., OCTOBER 2.

The tornado that occurred at Little Rock, Ark., on October 2, has a special interest from the fact that it is the first case in which the center of the tornado passed immediately over a Weather Bureau station and left a well-marked record on the self-registering instruments. A facsimile of the barometric trace is reproduced on Chart I, and the following account is quoted verbatim from the report of Mr. George S. Harkness, Weather Bureau observer at that station:

During the day the sky was obscured by a stratum of light gray clouds, gentle southwesterly winds prevailed, and the thermometer was a little above the normal for the season.

About sunset the clouds changed to cumulo-stratus in the west, and lightning began to play. By 6 p. m. the play of the lightning was almost continuous; it was not observed in flashes, but rather by reflection from above the bank of gathered clouds; the temperature rose perceptibly, but was not ominously oppressive. These conditions prevailed until about 7.55 p. m., when light, spitting rain began to fall.

At the time of the regular afternoon observation the cloud conditions were about as follows: Apparently the clouds were all nimbus, the rain being as described, light, but the drops were large. In the west there was a stratum of light gray clouds, above which was a dark series of two or three clouds, making an appearance like points of lace, very deep slate at the base and becoming a lighter coloring and thinner at the extremities. The base was in the west and the clouds pointed to the east. Directly overhead the clouds were of cumulo-stratus formation, and were in a state of violent agitation without any well-defined direction, though apparently moving with the mass from the south.

The thermometer at the observation registered 78; the barometer, corrected, 29.66; the wind, 14 miles per hour from the south; humidity, 77, which was low considering the conditions; and the dew-point was 70.

The conditions were such as have often been observed at this place in case of violent thunderstorms, and this section never having experienced a tornado, your observer was not prepared for the character of the storm which followed.

The first evidence of the storm is shown about two miles west of the city, apparently originating there. The storm cloud moved from the south to the north for half a mile, then, describing an angle, continued its course from southwest to northeast till it reached the Insane Asylum, which is on the western border of the city. The damage done up to this time was very slight, a few trees being uprooted or snapped off, a frame barn, a small frame house, and a few smaller buildings damaged to a greater or less extent, the width of the path varying from a few feet to 200 yards, and the storm cloud only touching the earth at intervals. The ground here is rather low and rises gently toward the east, the Insane Asylum being situated on the crest of this rise. Owing to its exposed position, the large buildings of this institution suffered great damage from the fury of the storm. For the space of 50 feet the east wall of the south wing, which was three stories high, was blown off completely, falling outward toward the east as though the force exerted was from inside, as is often the case with storms of this character. Describing the south side of the storm's path as the right side and the north side as the left side, this wall was nearly the center of the path. Another building on the right side was damaged to some extent. The main entrance on the left side was almost completely ruined, and directly at the entrance Dr. Ingate, the asylum physician, was killed by an iron ornament being torn from the roof and falling through the three floors to the ground floor, where he was at the time.

The direction in which the debris lay upon the ground indicated the spiral movement of the wind in the storm cloud. The asylum fence 100 yards from the building was in the storm's path. The fence was probably 200 yards long,